

**SAMSUNG DISPLAY****Samsung Secret**

Preliminary Spec

**DATE : 16. May. 2012****SAMSUNG TFT-LCD****MODEL : LTA400HL15**

The Information Described in this Specification is Preliminary and can be changed without prior notice

Samsung Display Co . , LTD.

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**\* Revision History****Samsung Secret**

| Date          | Rev. No | Page | Summary      |
|---------------|---------|------|--------------|
| 16. May. 2012 | 000     | all  | First issued |

## General Description

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### Description

**LTA400HL15** is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT (Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit.

The resolution of a 40.0" is 1920 x 1080 and this model can display up to 1.07B (Dithered 10bit) colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV and High Definition TV.

### Features

- RoHS compliance (Pb-free)
- High contrast & aperture ratio
- SPVA (Super Patterned Vertical Align) mode
- Wide viewing angle ( $\pm 178^\circ$ )
- High speed response (240Hz)
- FHD resolution (16:9)
- Low Power consumption
- White E-LED Backlight
- DE (Data Enable) mode
- 8 lane V-by-one Interface

## General Information

| Items               | Specification                                       | Unit              | Note            |
|---------------------|-----------------------------------------------------|-------------------|-----------------|
| Module Size         | 897.4(H <sub>TYP</sub> ) x 511.0(V <sub>TYP</sub> ) | mm                | ±1.0mm          |
|                     | 27(D <sub>max</sub> )                               |                   | Wall mount Stud |
| Weight              | 8300 (Max)                                          | g                 |                 |
| Pixel Pitch         | 0.12125(H) X 0.36375 (V)                            | mm                |                 |
| Active Display Area | 885.6(H) X 498.15(V)                                | mm                |                 |
| Surface Treatment   | Glare, 2H                                           | -                 | Glare           |
| Display Colors      | 1.07B - Dithered 10bit                              | Colors            |                 |
| Number of Pixels    | 1920 x 1080                                         | Pixel             |                 |
| Pixel Arrangement   | RGB vertical stripe                                 | -                 |                 |
| Display Mode        | Normally Black                                      | -                 |                 |
| Luminance of White  | 450 (Typ.)                                          | cd/m <sup>2</sup> |                 |

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## 1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

| Item                          | Symbol    | Min.    | Max. | Unit | Note |
|-------------------------------|-----------|---------|------|------|------|
| Power Supply Voltage          | $V_{DD}$  | GND-0.5 | 16   | V    | (1)  |
| Storage temperature           | $T_{STG}$ | -20     | 60   | °C   | (2)  |
| Operating temperature         | $T_{OPR}$ | 0       | 50   | °C   |      |
| Shock ( non - operating )     | X,Y       | -       | 30   | G    | (4)  |
| Vibration ( non - operating ) | $V_{NOP}$ | -       | 1.5  | G    | (5)  |

### 1.2 LED Unit Absolute Maximum Ratings

| Item                        | Symbol    | Max.    | Unit | Note                                                        |
|-----------------------------|-----------|---------|------|-------------------------------------------------------------|
| Operating Temperature Range | $T_{op}$  | -30~+70 | °C   | -                                                           |
| Storage Temperature Range   | $T_{STG}$ | -30~+70 | °C   | -                                                           |
| Forward Current             | $I_f$     | 180     | mA   | Duty 100% operation<br>@ 1 string (8block/PCB)              |
|                             | $I_{fp}$  | 214     | mA   | Duty 50% operation<br>@ 1 string (8block/PCB)               |
| Forward Voltage             | $V_f$     | 42.1    | V    | $I_{fp} = 180\text{mA}$ , Duty100%<br>@ 1block (6LED/block) |
|                             | $V_{fp}$  | 43.7    | V    | $I_{fp} = 214\text{mA}$ , Duty 50%<br>@ 1block (6LED/block) |

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Note (1)  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$

(2) Temperature and relative humidity range are shown in the figure below.

a. 90 % RH Max. ( $T_a \leq 39\text{ }^{\circ}\text{C}$ )

b. Relative Humidity is 90% or less. ( $T_a > 39\text{ }^{\circ}\text{C}$ )

c. No condensation

(3) Although abnormal visual problems can be occurred in  $T_{\text{SUR}}$  range, the polarizer is not damaged in this range.

(4) 11ms, sine wave, one time for  $\pm X, \pm Y, \pm Z$  axis

(5) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

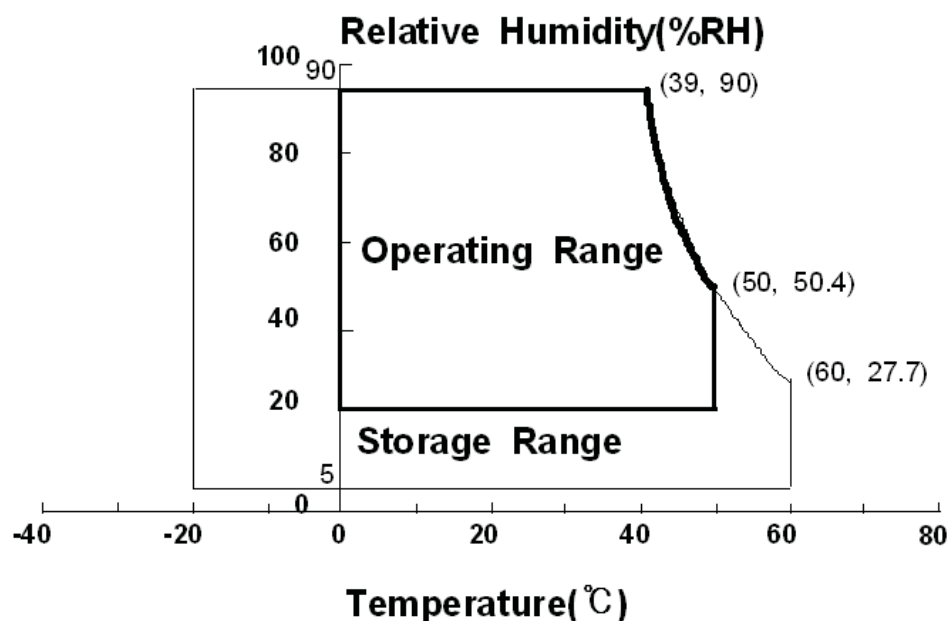


Fig. Temperature and Relative humidity range

## 2. Optical Characteristics

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The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : TOPCON RD-80S, TOPCON SR-3 ,ELDIM EZ-Contrast

(Ta = 25 ± 2 °C, VDD=12.0V, fv=240Hz, f<sub>DCLK</sub>=594 MHz, 2D Mode, Duty=100%)

| Item                                     |        | Symbol              | Condition                                                                         | Min.          | Typ.  | Max.          | Unit              | Note               |
|------------------------------------------|--------|---------------------|-----------------------------------------------------------------------------------|---------------|-------|---------------|-------------------|--------------------|
| Contrast Ratio<br>(Center of screen)     |        | C/R                 | Normal<br>$\theta_{\text{L,R}}=0$<br>$\theta_{\text{U,D}}=0$<br><br>Viewing Angle | 3,000         | 5,000 | -             |                   | (1)<br>SR-3        |
| Response Time                            | G-to-G | Tg                  |                                                                                   | -             | 8     | -             | msec              | (3)<br>RD-80S      |
| Luminance of White<br>(Center of screen) |        | Y <sub>L</sub>      |                                                                                   | 350           | 450   | -             | cd/m <sup>2</sup> | (4)<br>SR-3        |
| Color Chromaticity<br>(CIE 1931)         | Red    | Rx                  |                                                                                   | TYP.<br>-0.03 | 0.650 | TYP.<br>+0.03 |                   | (5),(6)<br>SR-3    |
|                                          |        | Ry                  |                                                                                   |               | 0.333 |               |                   |                    |
|                                          | Green  | Gx                  |                                                                                   |               | 0.308 |               |                   |                    |
|                                          |        | Gy                  |                                                                                   |               | 0.610 |               |                   |                    |
|                                          | Blue   | Bx                  |                                                                                   |               | 0.150 |               |                   |                    |
|                                          |        | By                  |                                                                                   |               | 0.061 |               |                   |                    |
|                                          | White  | Wx                  |                                                                                   |               | 0.280 |               |                   |                    |
|                                          |        | Wy                  | 0.290                                                                             |               |       |               |                   |                    |
| Color Gamut                              |        | -                   | -                                                                                 | 70            | -     | %             | (5)<br>SR-3       |                    |
| Color Temperature                        |        | -                   | -                                                                                 | 10,000        | -     | K             |                   |                    |
| Viewing Angle                            | Hor.   | $\theta_{\text{L}}$ | C/R≥10                                                                            | 75            | 89    | -             | Degree            | (6)<br>EZ-Contrast |
|                                          |        | $\theta_{\text{R}}$ |                                                                                   | 75            | 89    | -             |                   |                    |
|                                          | Ver.   | $\theta_{\text{U}}$ |                                                                                   | 75            | 89    | -             |                   |                    |
|                                          |        | $\theta_{\text{D}}$ |                                                                                   | 75            | 89    | -             |                   |                    |
| Brightness Uniformity<br>(9 Points)      |        | B <sub>uni</sub>    |                                                                                   | -             | -     | 27            | %                 | (2)<br>SR-3        |

### - Test Equipment Setup

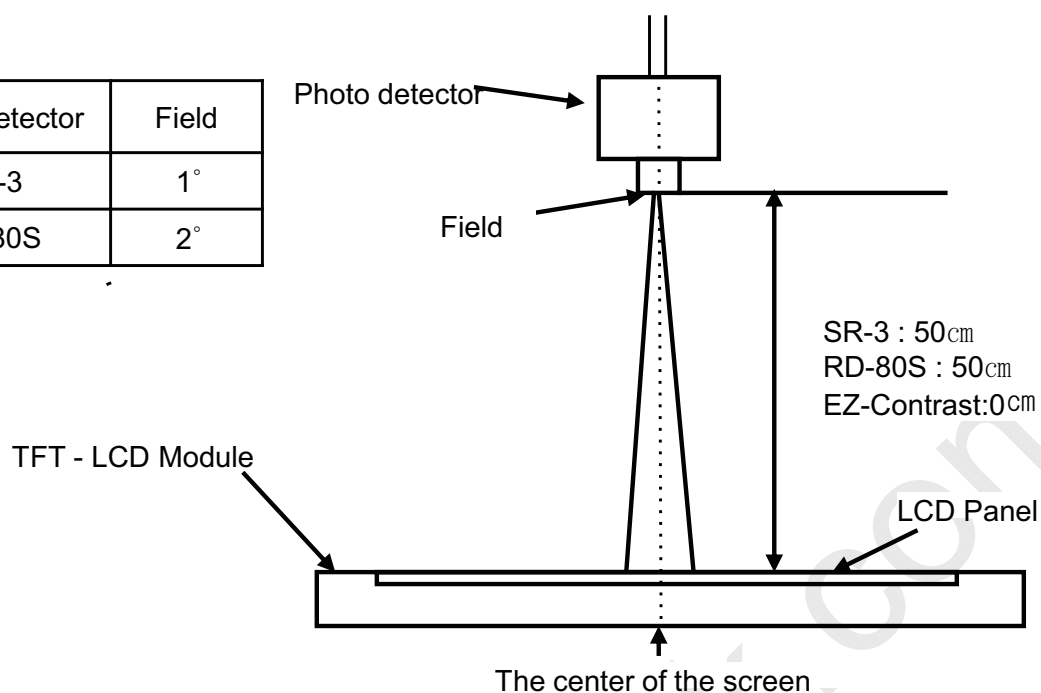
The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

. LED current = 120mA

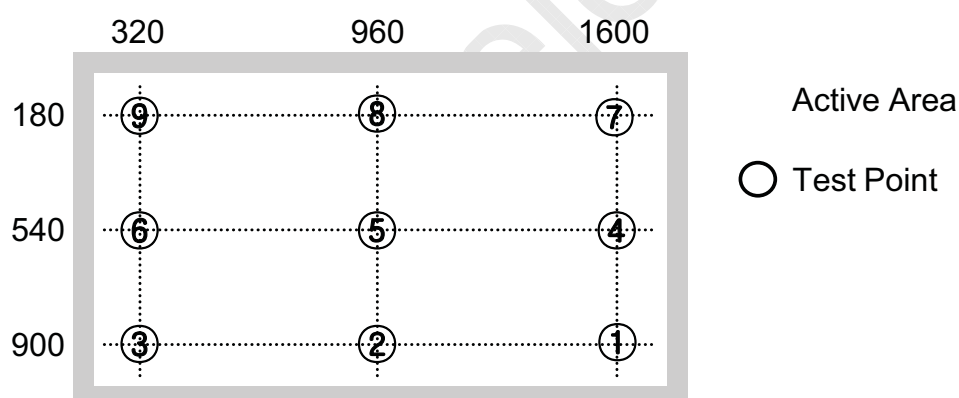
. Environment condition : Ta = 25 ± 2 °C

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| Photo detector | Field |
|----------------|-------|
| SR-3           | 1°    |
| RD-80S         | 2°    |



- Definition of test point



Note (1) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) &amp; gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black



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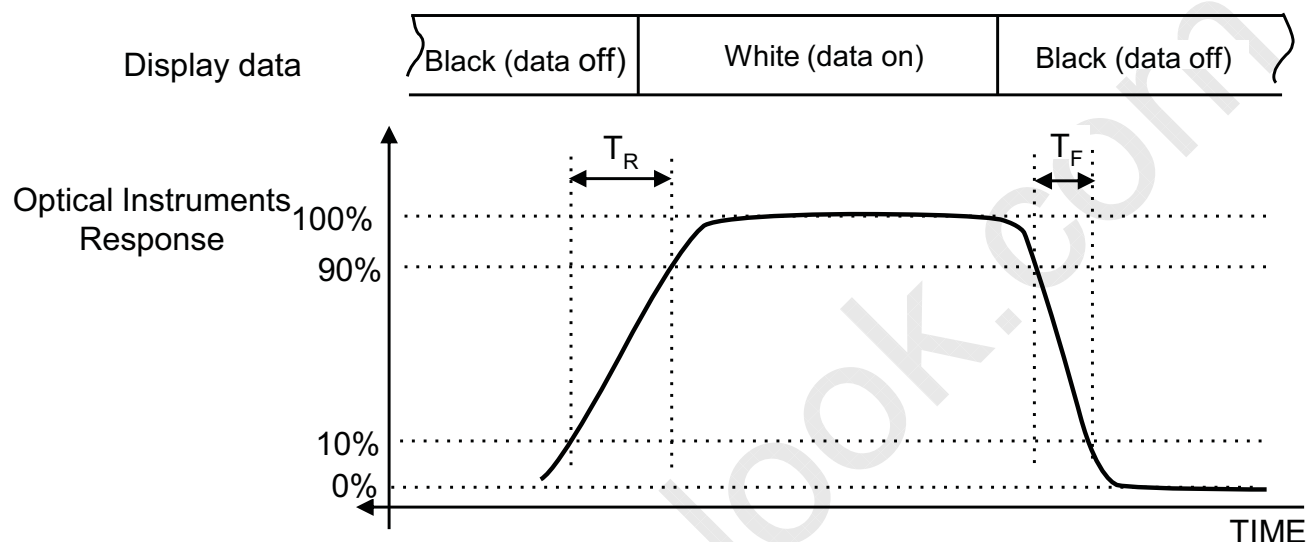
Note (2) Definition of 9 points brightness uniformity (Test pattern : Full White)

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

B<sub>max</sub> : Maximum brightness

B<sub>min</sub> : Minimum brightness

Note (3) Definition of Response time : Sum of T<sub>R</sub>, T<sub>F</sub>



※ G-to-G : Average response time between Gray to Gray (Scale)

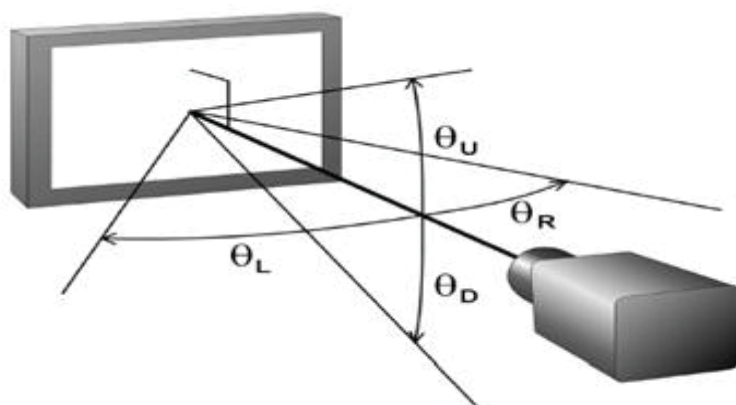
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤

Note (6) Definition of Viewing Angle

: Viewing angle range (C/R ≥ 10)



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### 3. Electrical Characteristics

#### 3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

$T_a = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$

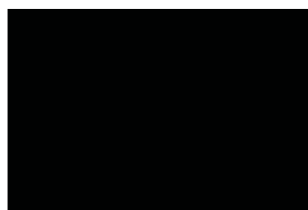
| Item                    |              | Symbol     | Min. | Typ. | Max. | Unit | Note    |
|-------------------------|--------------|------------|------|------|------|------|---------|
| Voltage of Power Supply |              | $V_{DD}$   | 10.8 | 12   | 13.2 | V    | (1)     |
| Current of Power Supply | (a) Black    | $I_{DD}$   | -    | 950  | 1050 | mA   | (2),(3) |
|                         | (b) White    |            | -    | 920  | 1020 | mA   |         |
|                         | (d) H-stripe |            | -    | 2200 | 2450 | mA   |         |
| Rush Current            |              | $I_{RUSH}$ | -    | -    | 5    | A    | (4)     |
|                         |              |            | Min. | Typ. | Max. | Unit |         |
| Vsync Frequency         |              | $f_V$      | 192  | 240  | 245  | Hz   |         |
| Hsync Frequency         |              | $f_H$      | 216  | 270  | 275  | kHz  |         |
| Main Frequency          |              | Fdclk      | 465  | 594  | 606  | MHz  |         |

Note (1) The ripple voltage should be controlled under 10% of  $V_{DD}$ .

(2)  $f_V=240\text{Hz}$ ,  $f_{DCLK}=594\text{ MHz}$ ,  $V_{DD}=12.0\text{V}$ , DC Current.

(3) Power dissipation check pattern (LCD Module only)

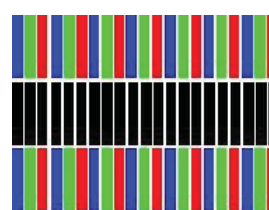
a) Black Pattern



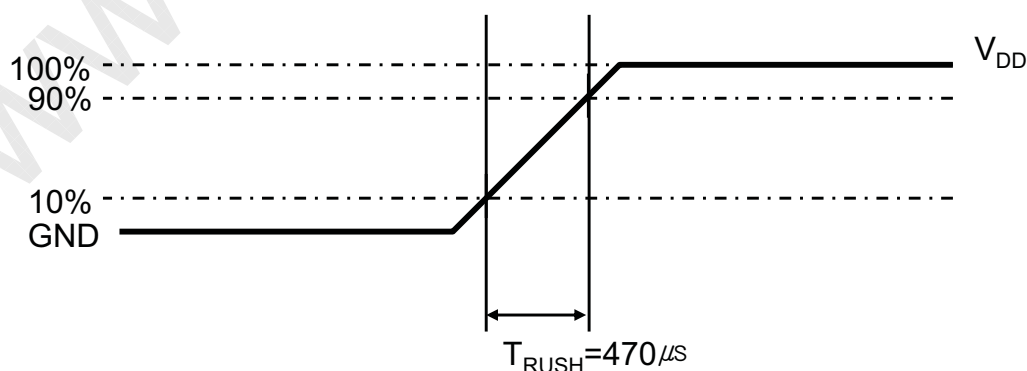
b) White Pattern



c) H-stripe



#### (4) Measurement Conditions



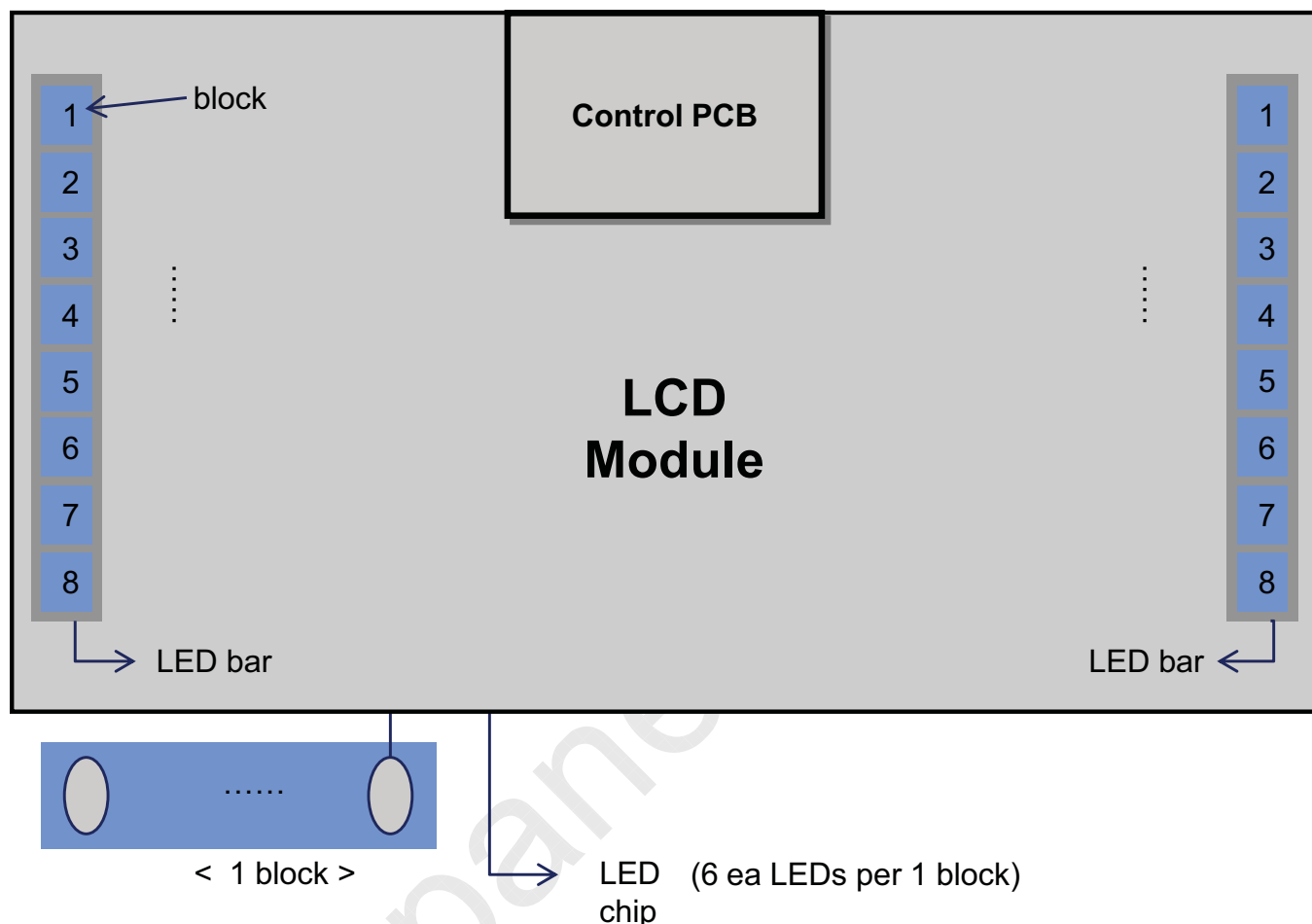
Rush Current  $I_{RUSH}$  can be measured when  $T_{RUSH}$  is  $470\mu\text{s}$ .

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### 3.2 Back Light Unit

 $T_a = 25 \pm 2^{\circ}\text{C}$ 

- Back light unit is composed of 2 –LED bars .(96 pcs of LEDs).



| Item                | Symbol | Min.   | Typ. | Max. | Unit | Note |
|---------------------|--------|--------|------|------|------|------|
| Operating Life Time | Hr     | 30,000 | -    | -    | Hour | (1)  |

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition :  $T_a = 25 \pm 2^{\circ}\text{C}$ ]

|    | Min | Typ. | Max  | Unit | Note                                            |
|----|-----|------|------|------|-------------------------------------------------|
| Vf | -   | 37.7 | 39.8 | V    | Each Block, Bar-voltage at $I_f = 120\text{mA}$ |

## 4. Input Terminal Pin Assignment

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### 4.1. Input Signal & Power

Connector : FX16K-51S-0.5SH ( Hirose )

| Pin | Symbol | Description         | Pin | Symbol    | Description                     |
|-----|--------|---------------------|-----|-----------|---------------------------------|
| 1   | 12V    | DC power supply     | 26  | GND       | Ground                          |
| 2   | 12V    | DC power supply     | 27  | REN       | Vbyone E -                      |
| 3   | 12V    | DC power supply     | 28  | REP       | Vbyone E +                      |
| 4   | 12V    | DC power supply     | 29  | GND       | Ground                          |
| 5   | 12V    | DC power supply     | 30  | GND       | Ground                          |
| 6   | NC     | NOTE1               | 31  | RFN       | Vbyone F -                      |
| 7   | GND    | Ground              | 32  | RFP       | Vbyone F +                      |
| 8   | HTPDN  | Vbyone link control | 33  | GND       | Ground                          |
| 9   | LOCKN  | Vbyone link control | 34  | GND       | Ground                          |
| 10  | GND    | Ground              | 35  | RGN       | Vbyone G -                      |
| 11  | RAN    | Vbyone A -          | 36  | RGP       | Vbyone G +                      |
| 12  | RAP    | Vbyone A +          | 37  | GND       | Ground                          |
| 13  | GND    | Ground              | 38  | GND       | Ground                          |
| 14  | GND    | Ground              | 39  | RHN       | Vbyone H -                      |
| 15  | RBN    | Vbyone B -          | 40  | RHP       | Vbyone H +                      |
| 16  | RBP    | Vbyone B +          | 41  | GND       | Ground                          |
| 17  | GND    | Ground              | 42  | NC        | NOTE1                           |
| 18  | GND    | Ground              | 43  | NC        | NOTE1                           |
| 19  | RCN    | Vbyone C -          | 44  | NC        | NOTE1                           |
| 20  | RCP    | Vbyone C +          | 45  | 3D_EN     | 3D Enable signal<br>Note 2      |
| 21  | GND    | Ground              | 46  | 3D sync_l | Shutter glass Sync Input signal |
| 22  | GND    | Ground              | 47  | 3D sync_o | Shutter Glass Sync Signal       |
| 23  | RDN    | Vbyone D -          | 48  | NC        | NOTE1                           |
| 24  | RDP    | Vbyone D +          | 49  | NC        | NOTE1                           |
| 25  | GND    | Ground              | 50  | NC        | NOTE1                           |
|     |        |                     | 51  | NC        | NOTE1                           |

Note 1 ) SEC internal Only: These PINS are used only for SAMSUNG. (DO NOT CONNECT)

Note 2 ) 3D Enable / 3D sync\_l, signal voltage level

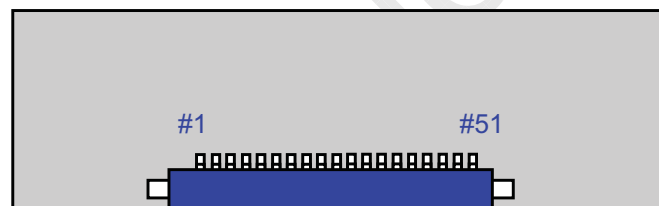
High : Min 3.0 V, Max 3.3 V    Low : Min 0 V, Max 0.4V

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Note(1) Pin number starts from left side

## T-con PCB

Pin # 1      Pin # 51

**Fig. Connector diagram**

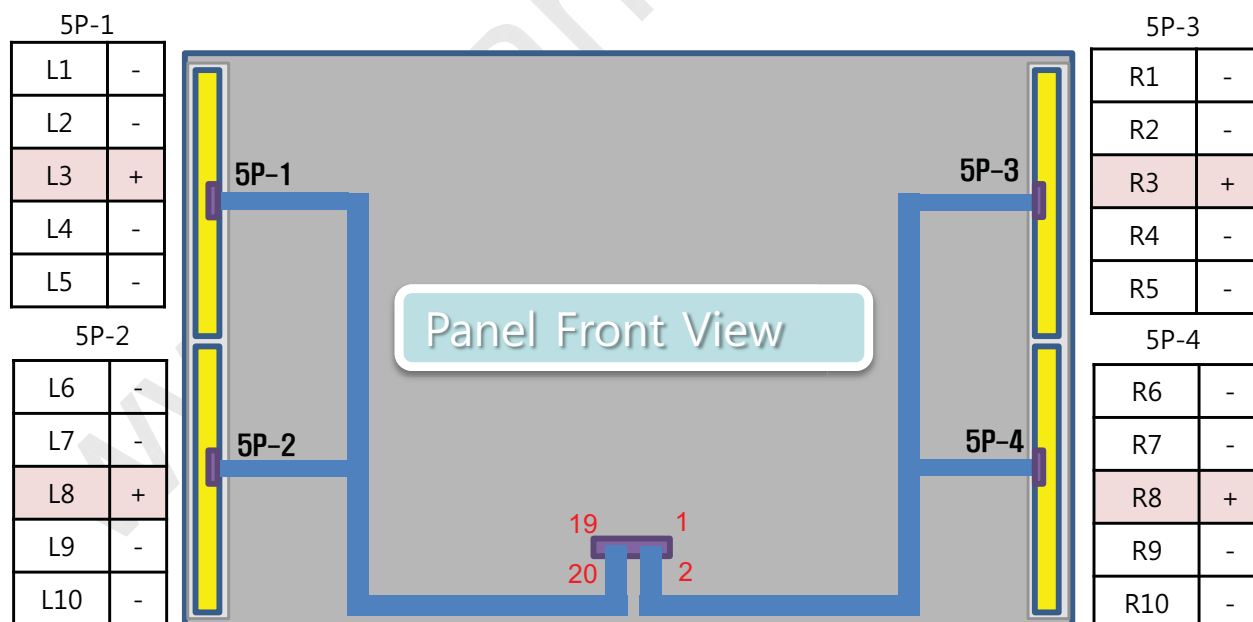
- a. Power GND pins should be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pin should be separated from other signal or power.

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## 4.2 LED Bar connector

Connector : SMAW200-H30S2(Yeonho)

| Pin# | Item | Pin# | Item |
|------|------|------|------|
| 1    | R3   | 11   | L10  |
| 2    | R8   | 12   | L9   |
| 3    | R1   | 13   | L7   |
| 4    | R2   | 14   | L6   |
| 5    | R4   | 15   | L5   |
| 6    | R5   | 16   | L4   |
| 7    | R6   | 17   | L2   |
| 8    | R7   | 18   | L1   |
| 9    | R9   | 19   | L8   |
| 10   | R10  | 20   | L3   |





## 4.3 V-by-1 Interface (T-con input)

- V-by-1 Receiver : THCV216

**Samsung Secret****Table 11 RGB/YCbCr444/RGBW/RGBY color data mapping**

| Mode       |            |            | Packer input & Unpacker output | 36bpp RGB /YCbCr444 | 30bpp RGB /YCbCr444 | 24bpp RGB /YCbCr444 | 18bpp RGB /YCbCr444 | 40bpp RGBW / RGBY | 32bpp RGBW / RGBY |      |
|------------|------------|------------|--------------------------------|---------------------|---------------------|---------------------|---------------------|-------------------|-------------------|------|
| 5byte mode | 4byte mode | 3byte mode | Byte0                          | D[0]                | R/Cr[4]             | R/Cr[2]             | R/Cr[0]             | -                 | R[2]              | R[0] |
|            |            |            |                                | D[1]                | R/Cr[5]             | R/Cr[3]             | R/Cr[1]             | -                 | R[3]              | R[1] |
|            |            |            |                                | D[2]                | R/Cr[6]             | R/Cr[4]             | R/Cr[2]             | R/Cr[0]           | R[4]              | R[2] |
|            |            |            |                                | D[3]                | R/Cr[7]             | R/Cr[5]             | R/Cr[3]             | R/Cr[1]           | R[5]              | R[3] |
|            |            |            |                                | D[4]                | R/Cr[8]             | R/Cr[6]             | R/Cr[4]             | R/Cr[2]           | R[6]              | R[4] |
|            |            |            |                                | D[5]                | R/Cr[9]             | R/Cr[7]             | R/Cr[5]             | R/Cr[3]           | R[7]              | R[5] |
|            |            |            |                                | D[6]                | R/Cr[10]            | R/Cr[8]             | R/Cr[6]             | R/Cr[4]           | R[8]              | R[6] |
|            |            |            |                                | D[7]                | R/Cr[11]            | R/Cr[9]             | R/Cr[7]             | R/Cr[5]           | R[9]              | R[7] |
|            |            | Byte1      | D[8]                           | G/Y[4]              | G/Y[2]              | G/Y[0]              | -                   | G[2]              | G[0]              |      |
|            |            |            | D[9]                           | G/Y[5]              | G/Y[3]              | G/Y[1]              | -                   | G[3]              | G[1]              |      |
|            |            |            | D[10]                          | G/Y[6]              | G/Y[4]              | G/Y[2]              | G/Y[0]              | G[4]              | G[2]              |      |
|            |            |            | D[11]                          | G/Y[7]              | G/Y[5]              | G/Y[3]              | G/Y[1]              | G[5]              | G[3]              |      |
|            |            |            | D[12]                          | G/Y[8]              | G/Y[6]              | G/Y[4]              | G/Y[2]              | G[6]              | G[4]              |      |
|            |            |            | D[13]                          | G/Y[9]              | G/Y[7]              | G/Y[5]              | G/Y[3]              | G[7]              | G[5]              |      |
|            |            |            | D[14]                          | G/Y[10]             | G/Y[8]              | G/Y[6]              | G/Y[4]              | G[8]              | G[6]              |      |
|            |            |            | D[15]                          | G/Y[11]             | G/Y[9]              | G/Y[7]              | G/Y[5]              | G[9]              | G[7]              |      |
|            |            | Byte2      | D[16]                          | B/Cb[4]             | B/Cb[2]             | B/Cb[0]             | -                   | B[2]              | B[0]              |      |
|            |            |            | D[17]                          | B/Cb[5]             | B/Cb[3]             | B/Cb[1]             | -                   | B[3]              | B[1]              |      |
|            |            |            | D[18]                          | B/Cb[6]             | B/Cb[4]             | B/Cb[2]             | B/Cb[0]             | B[4]              | B[2]              |      |
|            |            |            | D[19]                          | B/Cb[7]             | B/Cb[5]             | B/Cb[3]             | B/Cb[1]             | B[5]              | B[3]              |      |
|            |            |            | D[20]                          | B/Cb[8]             | B/Cb[6]             | B/Cb[4]             | B/Cb[2]             | B[6]              | B[4]              |      |
|            |            |            | D[21]                          | B/Cb[9]             | B/Cb[7]             | B/Cb[5]             | B/Cb[3]             | B[7]              | B[5]              |      |
|            |            |            | D[22]                          | B/Cb[10]            | B/Cb[8]             | B/Cb[6]             | B/Cb[4]             | B[8]              | B[6]              |      |
|            |            |            | D[23]                          | B/Cb[11]            | B/Cb[9]             | B/Cb[7]             | B/Cb[5]             | B[9]              | B[7]              |      |
|            |            | Byte3      | D[24]                          | -                   | -                   | -                   | -                   | R[0]              | -                 |      |
|            |            |            | D[25]                          | -                   | -                   | -                   | -                   | R[1]              | -                 |      |
|            |            |            | D[26]                          | B/Cb[2]             | B/Cb[0]             | -                   | -                   | G[0]              | -                 |      |
|            |            |            | D[27]                          | B/Cb[3]             | B/Cb[1]             | -                   | -                   | G[1]              | -                 |      |
|            | D[28]      |            | G/Y[2]                         | G/Y[0]              | -                   | -                   | B[0]                | -                 |                   |      |
|            | D[29]      |            | G/Y[3]                         | G/Y[1]              | -                   | -                   | B[1]                | -                 |                   |      |
|            | D[30]      |            | R/Cr[2]                        | R/Cr[0]             | -                   | -                   | W/Y[0]              | -                 |                   |      |
|            | D[31]      |            | R/Cr[3]                        | R/Cr[1]             | -                   | -                   | W/Y[1]              | -                 |                   |      |
|            | Byte4      | D[32]      | -                              | -                   | -                   | -                   | W/Y[2]              | W/Y[0]            |                   |      |
|            |            | D[33]      | -                              | -                   | -                   | -                   | W/Y[3]              | W/Y[1]            |                   |      |
|            |            | D[34]      | B/Cb[0]                        | -                   | -                   | -                   | W/Y[4]              | W/Y[2]            |                   |      |
|            |            | D[35]      | B/Cb[1]                        | -                   | -                   | -                   | W/Y[5]              | W/Y[3]            |                   |      |
|            |            | D[36]      | G/Y[0]                         | -                   | -                   | -                   | W/Y[6]              | W/Y[4]            |                   |      |
|            |            | D[37]      | G/Y[1]                         | -                   | -                   | -                   | W/Y[7]              | W/Y[5]            |                   |      |
|            |            | D[38]      | R/Cr[0]                        | -                   | -                   | -                   | W/Y[8]              | W/Y[6]            |                   |      |
|            |            | D[39]      | R/Cr[1]                        | -                   | -                   | -                   | W/Y[9]              | W/Y[7]            |                   |      |

**Samsung Secret**

#### 4.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

| COLOR                        | DISPLAY<br>(8bit)           | DATA SIGNAL |    |    |    |    |    |    |    |    |    |       |    |    |    |    |    |    |    |    |    |      |    |    |    |    |    |    |    | GRAY<br>SCALE<br>LEVEL |    |              |
|------------------------------|-----------------------------|-------------|----|----|----|----|----|----|----|----|----|-------|----|----|----|----|----|----|----|----|----|------|----|----|----|----|----|----|----|------------------------|----|--------------|
|                              |                             | RED         |    |    |    |    |    |    |    |    |    | GREEN |    |    |    |    |    |    |    |    |    | BLUE |    |    |    |    |    |    |    |                        |    |              |
|                              |                             | R0          | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | G0    | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | B0   | B1 | B2 | B3 | B4 | B5 | B6 | B7 |                        | B8 | B9           |
| BASIC<br>COLOR               | BLACK                       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | -            |
|                              | BLUE                        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | -            |
|                              | GREEN                       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | -            |
|                              | CYAN                        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | -            |
|                              | RED                         | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | -            |
|                              | MAGENTA                     | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | -            |
|                              | YELLOW                      | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | -            |
|                              | WHITE                       | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | -            |
| GRAY<br>SCALE<br>OF<br>RED   | BLACK                       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | R0 |              |
|                              | DARK<br>↑<br><br>↓<br>LIGHT | 1           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | R1           |
|                              |                             | 0           | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | R2           |
|                              |                             | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  | :                      | :  | R3~<br>R1020 |
|                              |                             | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  | :                      | :  |              |
|                              |                             | 1           | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | R1021        |
|                              |                             | 0           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | R1022        |
|                              | RED                         | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | R1023        |
| GRAY<br>SCALE<br>OF<br>GREEN | BLACK                       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | G0 |              |
|                              | DARK<br>↑<br><br>↓<br>LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | G1           |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | G2           |
|                              |                             | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  | :                      | :  | G3~<br>G1020 |
|                              |                             | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  | :                      | :  |              |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | G1021        |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | G1022        |
|                              | GREEN                       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | G1023        |
| GRAY<br>SCALE<br>OF<br>BLUE  | BLACK                       | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | B0 |              |
|                              | DARK<br>↑<br><br>↓<br>LIGHT | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | B1           |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0                      | 0  | B2           |
|                              |                             | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  | :                      | :  | B3~<br>B1020 |
|                              |                             | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  | :  | :  | :                      | :  |              |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 1  | 0  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | B1021        |
|                              |                             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | B1022        |
|                              | BLUE                        | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1                      | 1  | B1023        |

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage



## 5. Interface Timing

### 5.1 Timing Parameters (Tcon input)

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| SIGNAL                         | ITEM             | SYMBOL | Min. | Typ. | Max  | UNIT   | NOTE |
|--------------------------------|------------------|--------|------|------|------|--------|------|
| Clock                          | Frequency        | 1/TC   | 465  | 594  | 606  | MHz    | -    |
| Hsync                          |                  | Fh     | 216  | 270  | 275  | KHz    | (4)  |
| Vsync                          |                  | Fv     | 192  | 240  | 245  | Hz     |      |
| Vertical Active Display Term   | Display Period   | TVD    | -    | 1080 | -    | Lines  | -    |
|                                | Vertical Total   | TV     | 1110 | 1125 | 1800 | Lines  | -    |
| Horizontal Active Display Term | Display Period   | THD    | -    | 1920 | -    | Clocks | -    |
|                                | Horizontal Total | TH     | 2150 | 2200 | 2250 | clocks | -    |

Note) This product is H / V mode. The input of Hsync & Vsync signal is essentially needed.

(1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(2) Internal  $V_{DD} = 3.3V$

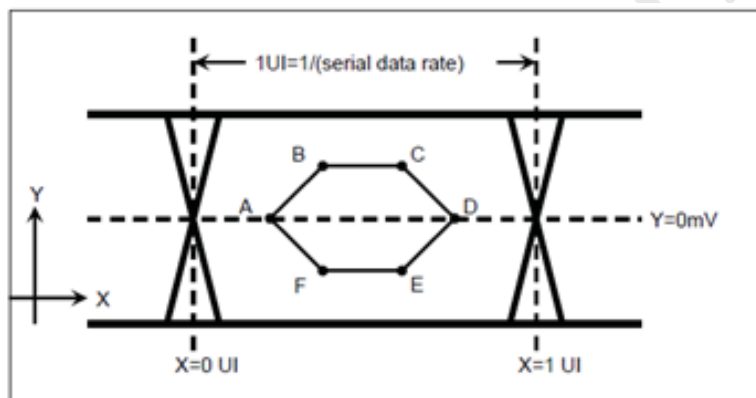
(3) Hsync, Vsync range is measured by increasing clock frequency.

### 5.2 Spread Spectrum

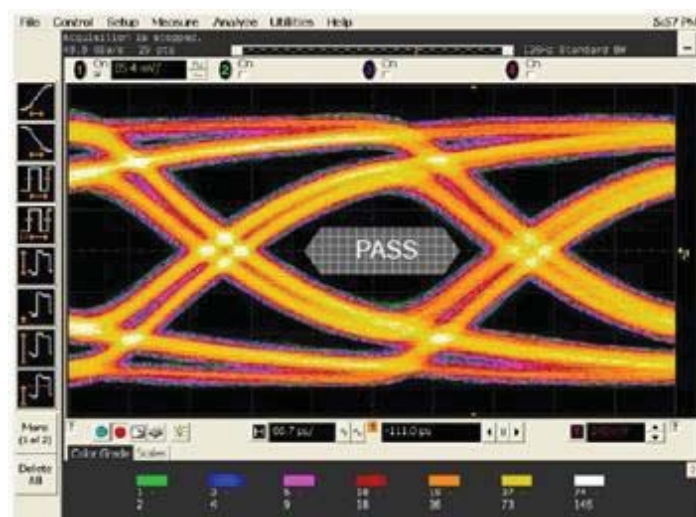
- Modulation rate (max) :  $\pm 0.5\%$

- Modulation Frequency : under 30 KHz

#### 5.3.1 V by one Rx EYE Specifications



|   | X[UI] | Y[mV] |
|---|-------|-------|
| A | 0.25  | 0     |
| B | 0.3   | 50    |
| C | 0.7   | 50    |
| D | 0.75  | 0     |
| E | 0.7   | -50   |
| F | 0.3   | -50   |



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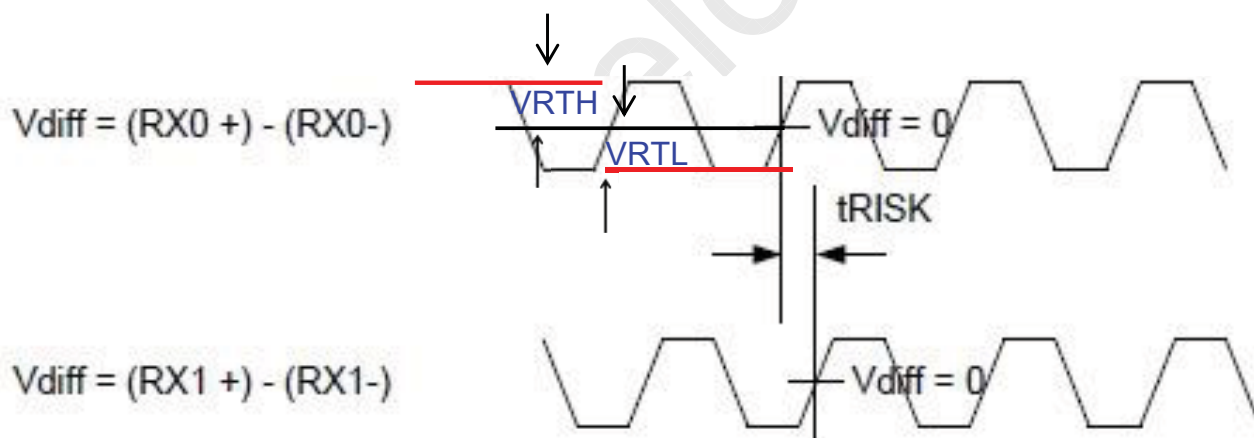
## 5.3.2 V by One Rx characteristics

| Symbol      | SYMBOL                            | Min | Typ | Max  | UNIT | Note |
|-------------|-----------------------------------|-----|-----|------|------|------|
| VRTH        | Differential Input High Threshold | -   | -   | 50   | mV   | (1)  |
| VRTL        | Differential Input Low Threshold  | -50 | -   | -    | mV   | (1)  |
| RRIN        | Differential Input Resistance     | 80  | 100 | 120  | ohm  |      |
| tRBIT (=UI) | Unit Interval                     | 266 | -   | 1667 | psec |      |
| tRISK_INTRA | Allowable Intra-pair Skew         | 0.3 | -   | -    | UI   | (2)  |
| tRISK_INTER | Allowable Inter-pair Skew         | 5   | -   | -    | UI   | (3)  |

Note (1) Refer below figure.

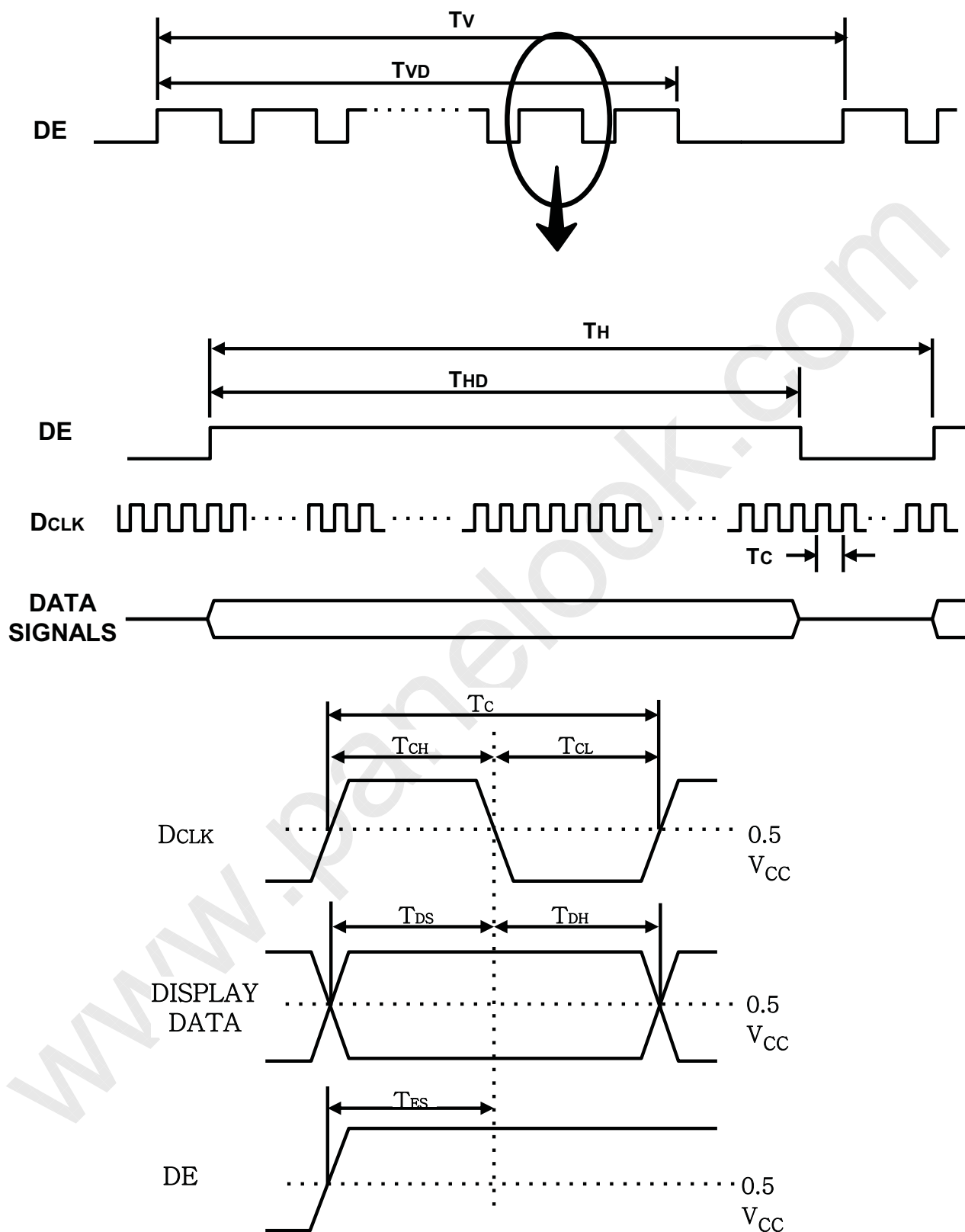
Note (2) Allowable intra-pair skew : data to data

Note(3) Allowable inter-pair skew : lane to lane (lane A ~ lane H)



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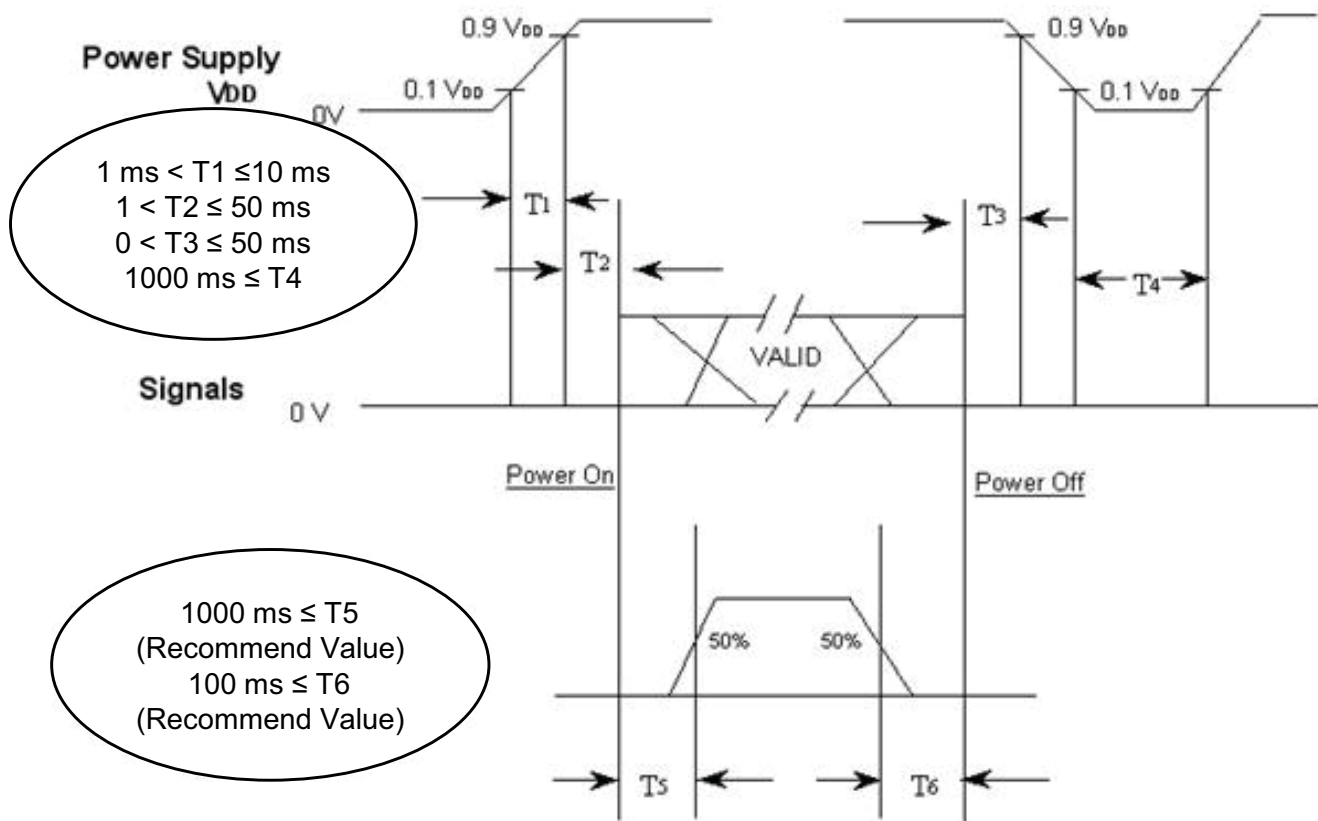
## 5.4 Timing diagrams of interface signal ( DE mode )



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## 5.5 Power ON/OFF Sequence (T-con input)

To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.



T1 : V<sub>DD</sub> rising time from 10% to 90%

T2 : The time from V<sub>DD</sub> to valid data at power ON.

T3 : The time from valid data off to V<sub>DD</sub> off at power Off.

T4 : V<sub>DD</sub> off time for Windows restart

T5 : The time from valid data to B/L enable at power ON.

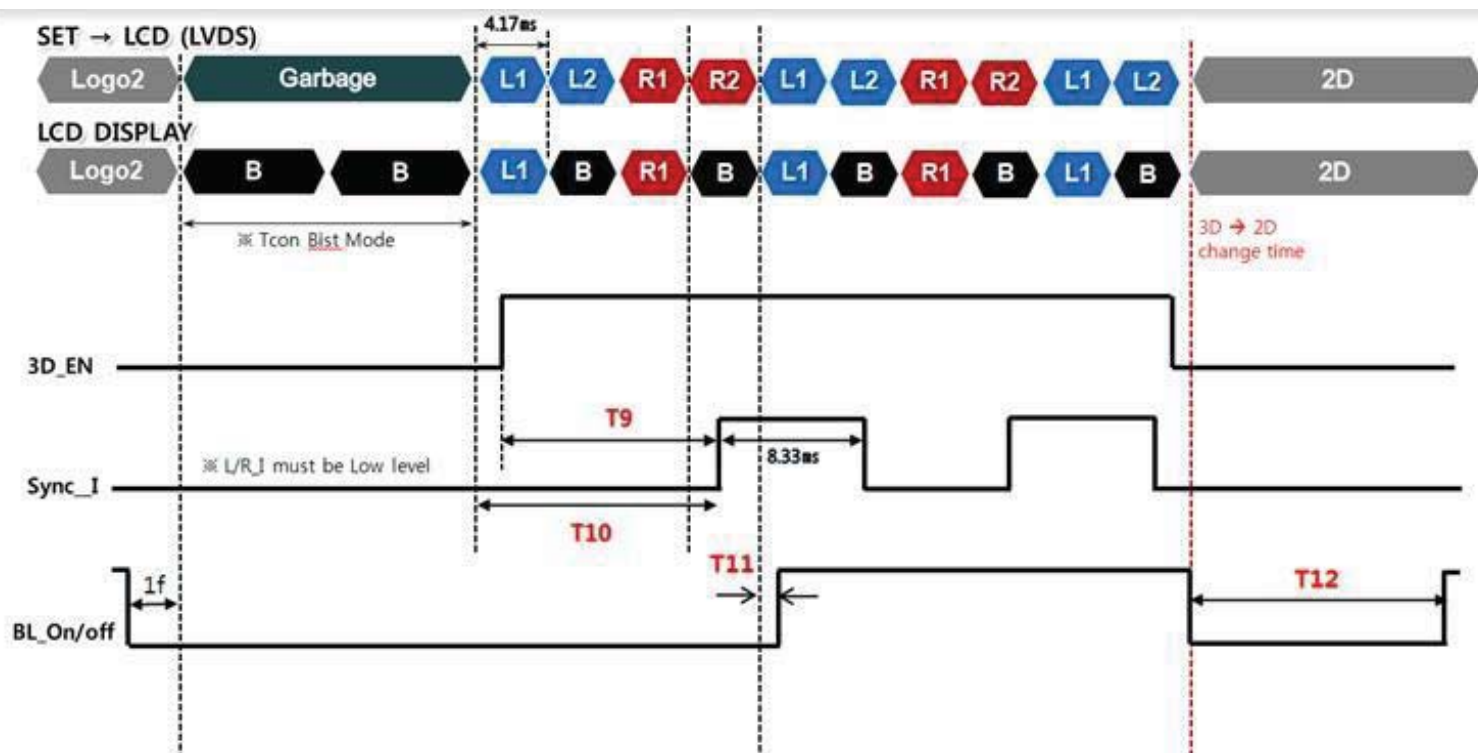
T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V<sub>DD</sub>.
- Apply the CCFL voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V<sub>DD</sub> = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

### 5.5.1 3D ON/OFF Sequence

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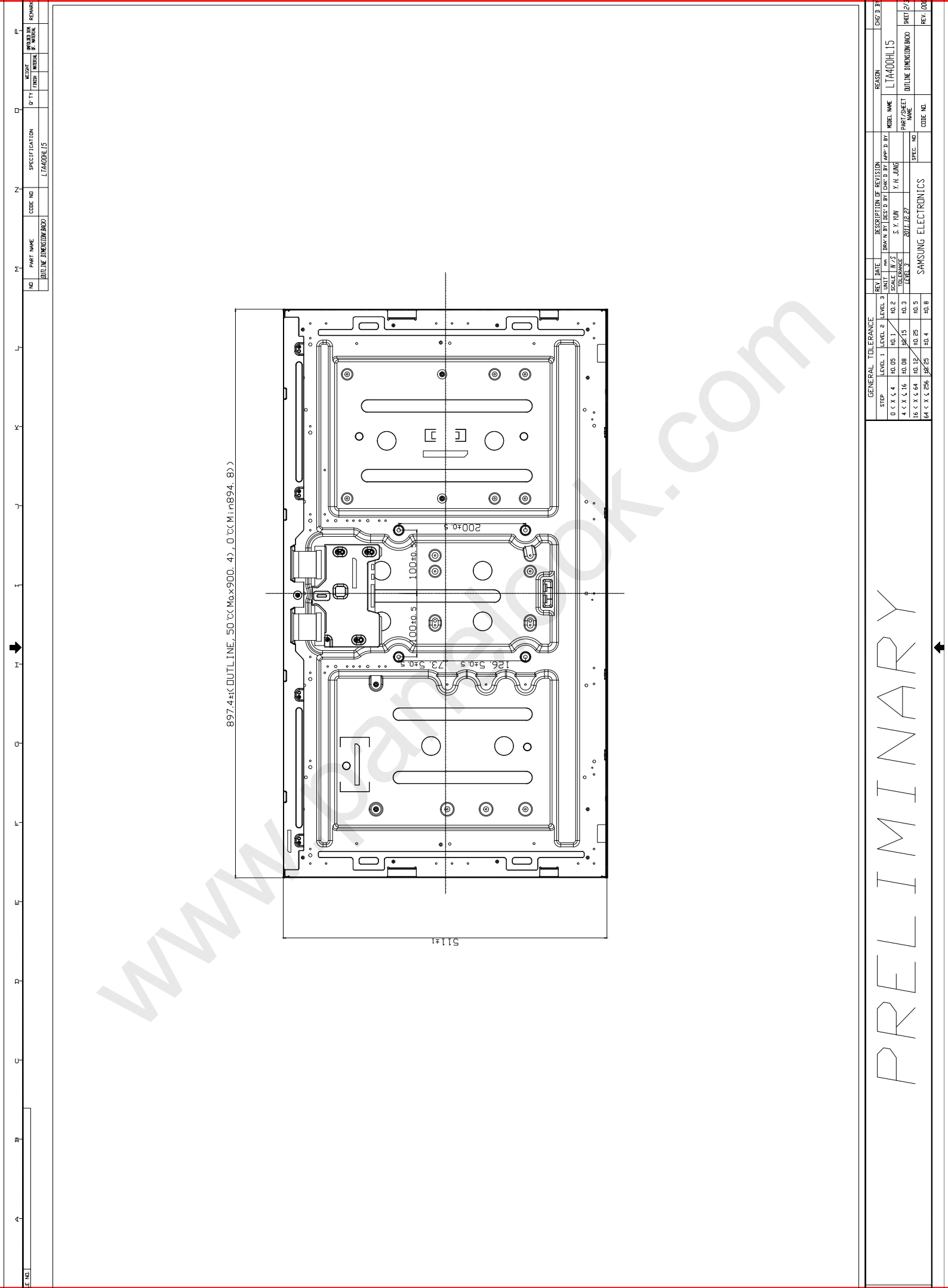
To prevent an abnormal display or garbage display of the LCD Module, the 3D on/off sequence should be as the diagram below.



| Timing | Spec (ms)             | Description                               |
|--------|-----------------------|-------------------------------------------|
| T9     | > 0                   |                                           |
| T10    | $12.51 < T10 < 16.68$ | $3 \text{ frame} < T10 < 4 \text{ frame}$ |
| T11    | $\geq 2.74$           |                                           |
| T12    | $\geq 16.0$           |                                           |

Note) Delay between 3D sync\_I and 3D sync\_o is 4.3ms.

# PRELIMINARY





## 7. Reliability Test

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| Item                    | Test condition                                                                                                     | Quantity |
|-------------------------|--------------------------------------------------------------------------------------------------------------------|----------|
| Temperature Step Stress | -20 ~ 60℃, 40hr, 5 Cycle determination                                                                             | 4EA      |
| HTOL                    | 50℃, 500hr determination                                                                                           | 8EA      |
| LTOL                    | 0℃, 500hr determination                                                                                            | 4EA      |
| HTS                     | 70℃, 500hr determination                                                                                           | 4EA      |
| LTS                     | -30℃, 500hr determination                                                                                          | 4EA      |
| THB                     | 40℃ / 95%RH, 500hr determination                                                                                   | 4EA      |
| WHTS                    | 60℃ / 75%RH, 250hr determination                                                                                   | 4EA      |
| Thermal Shock           | -20℃ ~ 60℃, 200cycle determination                                                                                 | 4EA      |
| ESD (operation)         | contact : ± 10 kV, 150pF/330Ω, 200Point, 1 time/Point<br>non-contact : ± 20 kV, 150pF/330Ω, 200Point, 1 time/Point | 3EA      |
| Vibration               | 10~300Hz/1.5G/10minSR, XYZ, 30min/axis                                                                             | 3EA      |
| Shock                   | Half Sine, 11msec, ± X 10G, ± Y 10G, ± Z 30G 1time/axis                                                            | 3EA      |

### [ Result Evaluation Criteria]

Under the display quality test conditions with normal operation state, these should be no change which may affect practical display functions.

- \* HTOL/ LTOL : High/Low Temperature Operating Life
- \* THB : Temperature Humidity Bias
- \* HTS/LTS : High/Low Temperature Storage
- \* WHTS : Wet Humidity Temperature Storage



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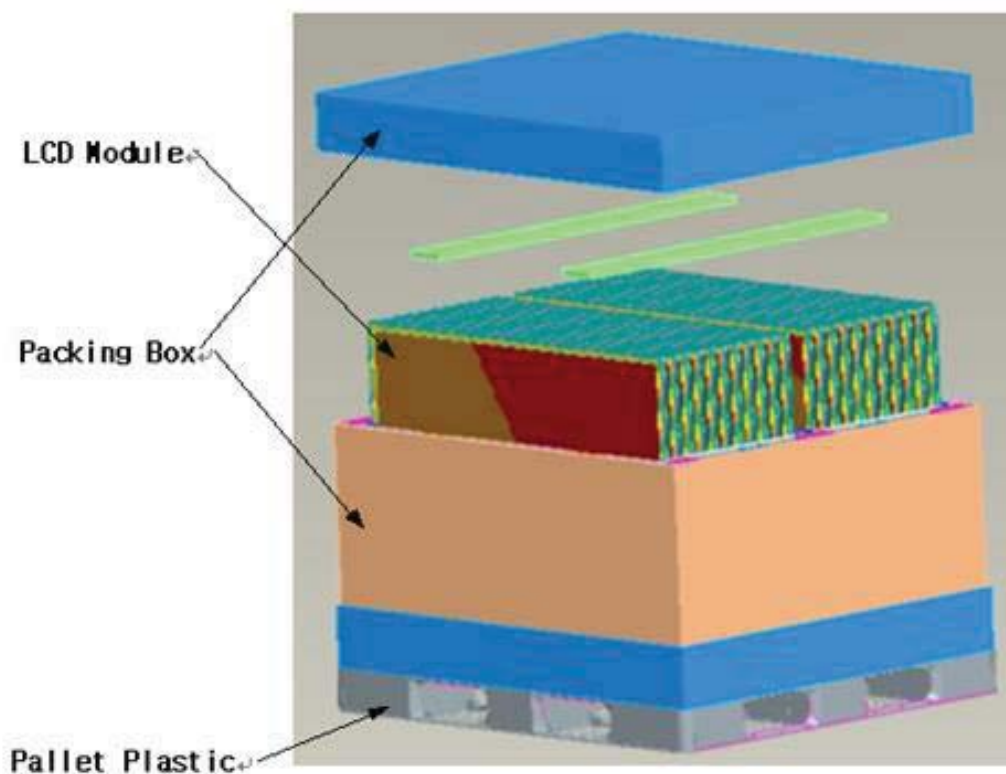
## 8. PACKING

### 8.1 CARTON (Internal Package)

#### (1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

#### (2) Packing Method



### 8.2 Packing Specification

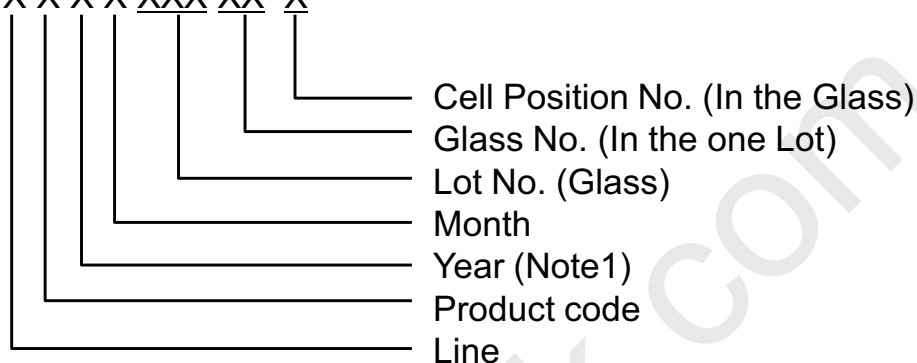
| Item                | Specification                      | Remark                                                                                      |
|---------------------|------------------------------------|---------------------------------------------------------------------------------------------|
| LCD Packing         | 18ea / Box<br>(Packing-Pallet Box) | 1. 7.3 Kg / LCD (18ea)<br>2. 23.8 Kg / Packing Box (1set)<br>> Packing Box Material : Paper |
| Pallet              | 1Box / Pallet                      | 1. Pallet weight = 5.3 kg<br>> Pallet Material : HDPE                                       |
| Packing Direction   | Vertical                           |                                                                                             |
| Total Pallet Size   | H x V x height                     | 1124mm(H) x 945mm(V) x 565mm(height)                                                        |
| Total Pallet Weight | 162 kg                             | Pallet(5.3kg) + Module(131.4kg) +<br>Packing BOX(23.8kg) + Silica-Gel(0.72kg)               |

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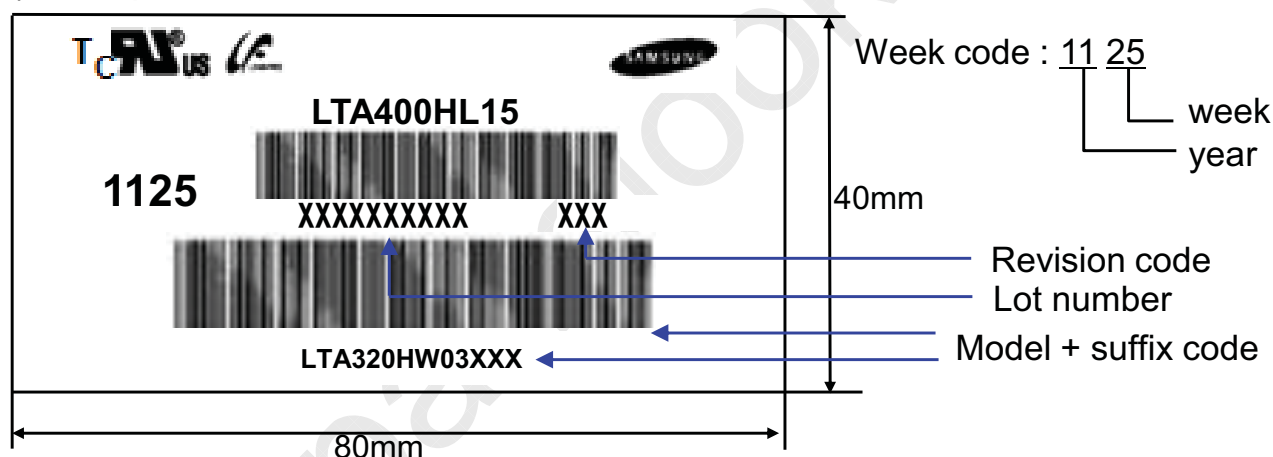
## 9. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

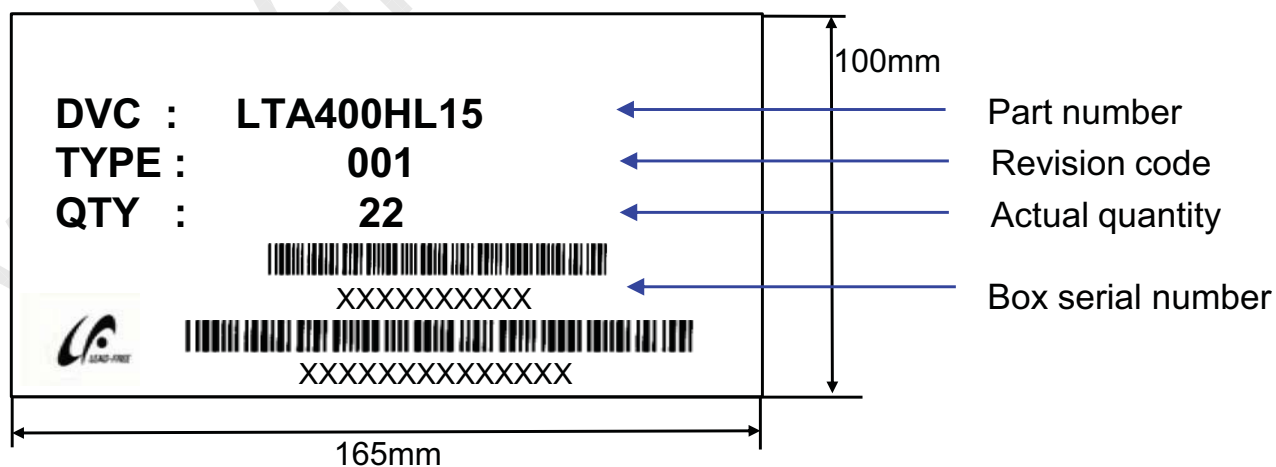
- (1) Part number : LTA400HL15  
 (2) Revision: Three letters  
 (3) Lot number : X X X X XXX XX X



### (4) Nameplate Indication



### (5) Packing box attach



## 10. General Precautions

**Samsung Secret**

### 10.1 Handling

- (a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.
- (b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.
- (c) Refrain from strong mechanical shock and / or any force to the Module.  
In addition to damage, this may cause improper operation or damage to the Module and LED back light.
- (d) Note that polarizers are very fragile and could be damage easily.  
Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) Desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.  
Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.
- (i) Protect the module from Electrostatic discharge. Otherwise the ASIC IC or Semiconductor would be damaged.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the Module.
- (l) Do not disassemble shield case of converter & C-PBA
- (m) Do not connect N.C pins. (Samsung internal use only)
- (n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized. Must put on antistatic glove while handle a module
- (o) Pins of I/F connector should not be touched directly with bare hands.

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## 10.2 Storage

We highly recommend to comply with the criteria in the table below.

| ITEM                | UNIT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Min. | Max. |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| Storage Temperature | (°C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 5    | 40   |
| Storage Humidity    | (%rH)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 35   | 75   |
| Storage Life        | 6 months                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |      |      |
| Storage Condition   | <ul style="list-style-type: none"><li>- The storage room should provide good ventilation and temperature control.</li><li>- Products should not be placed on the floor, but on the Pallet away from a wall.</li><li>- Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation.</li><li>- Avoid other hazardous environment while storing goods.</li><li>- If products delivered or kept in conditions of over the storage period of 3months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20 °C and a humidity of 50% for 24 hours.</li></ul> |      |      |

## 10.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

## 10.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.  
Normal condition is defined as below;
- Temperature :  $20 \pm 15^{\circ}\text{C}$
  - Humidity :  $55 \pm 20\%$
  - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

## 10.5 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. ( supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)  
Otherwise the Module may be damaged.
- (d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked " to the screen.  
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.